Abstract

Nature has bestowed a variety of plant species with ethnobotanical importance in natural habitats. Among these, wild plants with edible fruits are a specific type of non-timber forest products (NTFPs) that offer essential nutrients, socio-cultural and economic value, as well as traditional medicinal benefits. These wild edible fruits (WEFs) are those species that are not cultivated but instead collected from their natural habitats. These fruits are often classified as underutilized or neglected crops due to their occurrence in the wild or local-scale cultivation. Unfortunately, their economic potential is frequently overlooked, leading to limited traditional and local uses because their commercial potential is typically ignored. In addition to their traditional role as food, wild edible fruits offer numerous advantages, including medicinal properties and antioxidant effects. They contain important minerals such as sodium, potassium, magnesium, iron, calcium, and phosphorus. These minerals support immunological function and are frequently used in various formulations of Indian folk medicine. Researchers worldwide have extensively studied the nutritional values of wild edible fruits using different scientific and systematic approaches. Manipur, a state in northeast India, is home to diverse flora and fauna with a wide range of wild edible fruits and vegetables. The state is situated within the Himalaya and the Indo-Burma biodiversity hotspots and characterized by diverse physiographic and eco-climatic zones. These natural resources hold significant importance in the daily lives of local communities that are dependent on them for their means of subsistence and medicinal purposes. The harvesting of wild edible fruit from their

natural habitat has an impact on their population dynamics and poses a threat to their long-term survival. Additionally, it's critical to recognize and evaluate any potential biochemicals found in WEFs, which are regularly consumed by local people to fulfill their dietary needs. Many studies have examined the variety of wild edible fruits (WEFs), their therapeutic value, and their phytochemical characteristics. However, integrated approaches to comprehend ecological perspectives in terms of diversity, ethnobotanical values, population dynamics, survival and growth, and phytochemical characteristics are in very limited and in fact extremely rare in Manipur. Therefore, the present study aims to narrow down the existing research gap and improve the ecological understanding of the diversity of wild edible fruit plant through population ecology, ethnobotanical properties, physiological properties, as well as compound characterization of biochemical constituents in wild edible fruits of Manipur. The thesis consists of seven chapters, presenting the investigation and its findings.

Chapter 1 initiates with a general introduction, emphasizing the crucial role of wild edible fruits in local communities. The chapter deals historical account of fruits, supported by illustrative examples. Additionally, it explores the diverse range of wild edible fruits found across different parts of the world. Furthermore, the chapter addresses about the utilization of wild edible fruits to tackle food security concerns, particularly during periods of food crisis, with relevant scholarly references. The discussion also encompasses the significance of wild edible fruits in ethnobotany and highlights their nutritional value.

Chapter 2 entails an extensive literature review that investigates and reports on the studies conducted by different researchers pertaining to the aims and objectives of the present study. The review of literature reveals a noticeable scarcity of research conducted on the topic of wild edible fruits in Manipur.

Chapter 3 presents the records on the investigation and documentation of the population structure of wild edible fruit plants in Manipur. The chapter focuses on the remarkable diversity of wild edible fruits found within two community forests, namely, Machi community forest and Minou community forest. The study identified a total of 31 fruit species from 26 genera across 21 families. Notably, 26 of these species were found to be commercially available in local markets, indicating their

varying levels of total phenol, flavonoid, and tannin contents. Among them, *Microcos paniculata* L. demonstrates the highest phenol content (5.51 mg GAE/g), *Phyllanthus emblica* L. has the highest flavonoid content (183.90 mg QE/g), and *Averrhoa carambola* L. exhibits the highest tannin content (76.74 mg TAE/g). Additionally, the antioxidant activity, vitamin C, vitamin B1, and vitamin B2 content are also analysed, revealing significant variations among the fruit samples. Notably, *Phyllanthus emblica* L. demonstrates the highest antioxidant activity as well as the highest vitamin C content. Mineral analysis reveals varying levels of potassium, sodium, magnesium, calcium, iron, copper, manganese, and zinc in the fruits. Among the eight minerals analysed, potassium levels in the 15 fruits investigated in this study are found to be the highest of the eight minerals analyzed, ranging from 35.14 to 8738.74 mg/100g. Overall, this chapter provides comprehensive insights into the physico-chemical composition and nutritional value of wild edible fruits.

Chapter 6 is dedicated to the investigation and characterization of bioactive compounds extracted from potent wild edible fruits. Fruits of fifteen wild edible fruit species, *Antidesma bunius, Averrhoa carambola, Dillenia indica, Elaeocarpus floribundus, Ficus cunia, Garcinia pedunculata, Garcinia xanthochymus, Microcos paniculate, Phylanthus emblica, Psidium guajava, Rhus semialata, Solanum betaceum, Spondius pinata, Vangueria spinosa,* and *Zizyphus mauritiana* were selected for the purpose of study. The aim of this study was to identify and analyse the compounds present in the fruit samples using sophisticated techniques such as Fourier Transform Infrared Spectroscopy (FTIR) and Liquid Chromatography-Mass Spectrometry (LCMS). The FT-IR spectra analysis revealed the presence of four prominent peaks within the range of 1500-4000 cm^{-1} in all fifteen fruit samples. Functional groups such as OH-groups or carboxylic acid groups were detected in all the fruit samples, while alkenes (C=C stretch) groups were observed in all fruits except *Rhus semialata* Murr. The antimicrobial activity of the aqueous and ethanolic extracts obtained from the fifteen wild edible fruits was evaluated against various test organisms to identify the most effective fruit sample for further compound analysis. The results indicated that both extracts exhibited antimicrobial activity, with the ethanolic extract demonstrating higher effectiveness compared to the aqueous extract.

Consequently, seven fruits were selected for LCMS analysis. The LCMS analysis was conducted to profile the compounds present in these seven wild edible fruits. The results of the LCMS analysis revealed that the dominant group of identified metabolites in this study were alkaloids and their derivatives, constituting a range of 3.91% to 40.47% of the total composition. Organic acids also contributed significantly, ranging from 3.24% to 39.35% of the identified metabolites. Sugar content of the analysed fruits ranged from 3.8% to 31%, while the fatty acid/lipid content of the fruits ranged from 3.59% to 19.94%. Additionally, phenolic compounds, tannins, flavonoids, and benzenoids were detected in varied amounts. The LCMS analysis further identified additional steroid compounds, including physalin I, in the wild edible fruits of Manipur.

Chapter 7 presents a comprehensive summary and conclusion of the study. It highlights the major findings and emphasizes the importance of conserving these fruits in their natural habitats. The chapter also calls for further research to explore the pharmacological applications and potential domestication of wild edible fruits in different agro-climatic conditions. Overall, this chapter underscores the significance of the study and identifies future directions for research in this field.